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Letter

Element loss to platinum capsules in high-temperature–pressure experiments

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Abstract

Element partition coefficients play key roles in understanding various geological processes and are typically measured by performing high-temperature–pressure (HTP) experiments. In HTP experiments, samples are usually enclosed in capsules made of noble metals. Previous studies have shown that Fe, Ni, and Cu readily alloy with noble metals, resulting in significant loss of these elements from the experimental samples. The loss of elements could severely undermine phase equilibrium and compromise the validity and accuracy of the obtained partition coefficients. However, it remains unclear if other elements (in addition to Fe, Ni, and Cu) will also be lost from samples during HTP experiments, and how to minimize such losses. We performed a series of experiments at 1 GPa and 1400 °C to investigate which elements will be lost from samples and explore the influence of capsule materials and oxygen fugacity (f_{O_2}) on the loss behavior of elements. The starting material is a synthesized basaltic glass consisting of 8 major elements and 37 trace elements. The sample capsules included platinum (Pt), graphite-lined Pt, and rhenium-lined Pt, and the experimental oxygen fugacity (f_{O_2}) was buffered from <FMQ-2 to ~FMQ+5. Results show that: (1) 15 elements (V, Cr, Mn, Fe, Co, Ni, Cu, Zn, Ga, Ge, Cd, In, Sn, W, and Mo) were lost from the sample due to direct contacting and alloying with Pt under graphite-buffered conditions; (2) graphite and Re lining can physically isolate the starting material from Pt and prevent the loss of V, Cr, Mn, Fe, Zn, Ga, Ge, Cd, In, Sn, W, and Mo, but only slightly reduce the loss of Ni and Cu; and (3) element loss can be significantly reduced under oxidizing conditions, and all elements except Cu were retained in the samples under Ru–RuO_2 buffered conditions. These findings provide several viable capsule assemblies that are capable of preventing or reducing element loss, which may prove useful in determining accurate partition coefficients in HTP experiments.

Keywords: Element loss, high-temperature–pressure experiments, capsule materials, experimental f_{O_2}